

Urban Planning for Extreme Weather Events: Lessons Learnt from Recent Disasters in India

Tanya*, Monica Munjial Singh**

Abstract

Urban planning is significantly challenged by climate change, which calls for a paradigm shift in the way cities are planned and managed. Urban regions are more vulnerable to catastrophic weather events, rising sea levels, and resource scarcity as global temperatures rise. Resilient infrastructure, such as structures resistant to flooding, improved drainage systems, and green roofs, must be incorporated into urban plans in order to lessen the effects of disasters. Involving the community is essential to building resilience and guarantees that disaster response plans are appropriate for the situation and take into account the specific requirements of various communities. In addition to giving citizens more authority, this participative method fortifies social networks, which are essential in times of crisis. Planning strategies must prioritise resilience in order to provide safe, flexible, and sustainable urban environments for future generations as urban populations continue to rise. This abstract underscores the necessity for an interdisciplinary approach combining urban design and environmental sustainability in order to ensure that urban areas are well equipped to cope with the evolving nature of disaster threats and are therefore safe and secure to reside.

Keywords: Climate Change, Urban Planning, Community Role, Disaster

INTRODUCTION

India is one of the 10 worst disaster-prone countries in the world. India is vulnerable to a large number of natural and human-made disasters on account of its unique geo-climatic and socio-economic conditions. Disasters occur in India with grim regularity, causing enormous loss of life and property. According to the 2023 World Risk Report, India has a Disaster Risk Index of 41.52, ranking third globally for highest disaster risk (WorldRiskReport 2023, 2023). Out of the 36 states and union territories in the country, 28 states are disaster-prone. Almost 85% of the country is vulnerable to single or multiple disasters. As of 2023, India faces a complex and increasingly severe disaster scenario, influenced heavily by climate change and socio-economic factors, which are highlighted in the report published by Aon Plc: *Climate and Catastrophe Insight Report of 2024* (Climate and Catastrophe Insight, 2024). Disasters in India often disproportionately affect vulnerable populations, including low-income communities, women, and children. Aon plc reports show that these groups are more susceptible to the impacts of disasters and the challenges they face in recovery and resilience-building. Disasters in India have significant social impacts, including large-scale displacement, health crises, and educational disruption. Events like floods, earthquakes, and cyclones displace thousands of people, disrupting social networks and leading to

* Research Scholar, Centre for Social Work, Panjab University, Chandigarh, India. Email: tanyachandel99@gmail.com (Corresponding author)

** Professor and Chairperson, Centre for Social Work, Panjab University, Chandigarh, India.

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increased vulnerability and health issues, such as the spread of diseases in crowded shelters. The destruction of infrastructure and homes also disrupts livelihood activities and education, as businesses close and schools are damaged. These disruptions can have long-term effects on community stability, health, and future opportunities, highlighting the need for effective disaster preparedness and resilient recovery strategies.

Climate change and urban planning are connected in one way or another. Approximately 31.16% of the population of India lives in urban areas, and this trend is continuously increasing due to better employment opportunities, healthcare facilities, education, and improved infrastructure and amenities (Census of India, 2011). Furthermore, according to the report released by NITI Aayog titled *Reforms in urban planning capacity in India*, the COVID-19 pandemic was indicative of the fact that cities should become healthy by 2030 (Reforms in urban planning capacity in India, 2021). It was a wake-up call to the global community, including India, that urgent steps should be taken to make cities resilient, sustainable, and inclusive. Another report, synthesised in 2023, titled *The Intergovernmental Panel on Climate Change (IPCC) AR6*, emphasised that anthropogenic activities are the major determinants of climate change, and if this is not taken into consideration, the world will have to suffer harsh consequences of extreme weather events such as urban flooding, urban heat islands (heatwaves), droughts, cyclones, and wildfires (AR6 Synthesis Report, 2023).

REVIEW OF LITERATURE

The study is titled *Causes and Impacts of Urban Floods in Indian Cities: A Review* and the authors are Hari Ilam Vazhuthi N. and Ashwani Kumar (2020). This review article was published in the *International Journal on Emerging Technologies*. This paper focuses on direct and indirect factors that contribute to urban floods and their impact on the urban environment in various Indian cities. Secondary data sources were used in this research paper. The authors highlighted various meteorological, hydrological, and anthropogenic factors responsible for urban floods. The paper also mentions urbanisation as a pressing issue and states that as the city urbanises, the risk of urban floods increases up to threefold. Authorities like the National Disaster Management Authority (NDMA)

realised the importance of preparedness only after the devastating floods in various Indian cities like the Chennai floods (2015) and Kerala floods (2018). Before this, the authorities focused primarily on mitigation rather than preparedness. Anthropogenic activities were often blamed for urban flood situations, which were termed man-made disasters in various reports and articles. Some of the suggestions made by the authors for effectively managing urban floods are clearing the catchment area rivers of debris, relocation of people residing near river banks, instilling awareness regarding flood preparedness among communities, and protecting green covers (Kumar, 2020).

The title of the research paper is *Causes, Impacts, and Mitigation Strategies of Urban Pluvial Floods in India: A Systematic Review* and the authors are Harman Singha, Miriam Nielsenb, and Helen Greatrex (2023). It was published in the *International Journal of Disaster Risk Reduction*. The objectives of this paper were to understand the causes, impacts, and mitigation strategies for coping with urban floods in India. Secondary data were collected from academic databases after 2010 to ensure that recent literature was reviewed. A total of 62 articles were reviewed, and it was found that the two most important factors responsible for urban floods are extreme rainfall ($n = 51$) and urbanisation ($n = 44$). The paper highlights that anthropogenic activities were responsible for climate change, which in turn altered rainfall patterns in Indian cities. The study highlights that lakes, wetlands, and ponds that served as sinks for rainwater have nearly disappeared in many cities of India like Cuttack, Hyderabad, and Kolkata. The mitigation measures suggested by the authors focused on three parts, namely: proactive (improving the drainage system, revival of water bodies, and green cover), reactive (early warning alarm systems, use of social media to disseminate emergency numbers), and recovery (distribution of relief materials, legal assistance, clearing silt) (Harman Singha, 2023).

The title of the research paper is *Urban Drainage Management: Evaluating Drainage Infrastructure and Flood Resilience in Delhi City* and the authors are Anika Passi, Tanuj Goswami, Tushar Agrawal, and Dr Geeta Singh (2024). It was published in the *International Journal of Humanities, Social Science and Management*.

This study focuses on the causes of flood risks in Delhi as well as the current deficiencies in the drainage system of the national capital, comparing it with other modern drainage systems across the world. The major findings showed that 60% of Delhi's sewage remains untreated and is discharged directly into the Yamuna river, causing the drainage system to fail in handling such volumes of water during heavy rainfall, leading to flooding in low-lying areas of Delhi. It was found by the Delhi Jal Board that 1,600 unauthorised colonies were built across the Yamuna along drainage channels, increasing the risk of flooding. Efficient drainage system models in countries like the Netherlands, Tokyo, and Singapore could be studied to improve flood resilience in India. The suggestions made by the authors were single ownership of Delhi's drainage infrastructure, rejuvenation of water bodies, and awareness campaigns on waste disposal methods (Anika Passi, 2024).

The title of the study is *Flood Management in India: A Focused Review on the Current Status and Future Challenges* and the authors are Mohit Prakash Mohanty, Sahil Mudgil, and Subhankar Karmakar (2020). It was published in the *International Journal of Disaster Risk Reduction*. The study focuses on the flood-prone regions of India built along major river banks including the Ganga, Brahmaputra, Indus, Krishna, Narmada, and Godavari. The authors also discussed the role of various Indian authorities in controlling floods effectively. The major findings showed that among all river basins, the Ganga and Brahmaputra experienced the maximum number of floods from 1985 to 2018. Most of the cities prone to flooding in India, like Mumbai, Chennai, and Bengaluru, have poor drainage infrastructure, high rates of urbanisation, improper flood zoning, and illegal encroachments built along river banks. The authors also highlighted the role of various national-level organisations in flood preparedness like the Central Water Commission (CWC), NDMA, and state-level organisations like the Public Works Department (PWD). Some of the recommendations included training communities for effective flood preparedness, rainwater harvesting, a central database for all flood-related situations, and implementation of building codes (Mohit Prakash Mohanty, 2020).

The above literature highlights the major causes behind urban flooding in India and how it has exacerbated over

recent times, especially in urbanised cities like Delhi, Mumbai, Kerala, and Bengaluru. The causes of urban flooding are both natural and anthropogenic, but the latter have further worsened the natural causes. Climate change, urbanisation, poor drainage infrastructure, loss of wetlands, green covers, poor disposal practices are some of the major causes of urban flooding in Indian cities. The literature also examines the gaps in effective drainage infrastructure in India, which hinder efforts to combat flooding disasters. In order to lessen the effects of urban floods in India, the findings highlight the necessity of comprehensive flood control plans that incorporate infrastructure upgrades with climate adaptation, urban planning reforms, and public participation.

RESEARCH METHODOLOGY

The areas selected for the study are Delhi and Himachal Pradesh, both of which have faced significant urban flooding in recent times. A descriptive and exploratory research design is used by analysing secondary data from the census, meteorological data, government authorities (NDMA and SDMA), research papers, newspapers, and articles. Both qualitative and quantitative data are used.

Scope of the Study: The study focuses on urban flooding trends, causes, and suggestions to mitigate urban flooding in Delhi, a highly urbanised region, and Himachal Pradesh, a state that experiences flooding due to its topography and unique climatic conditions.

Objectives: The main objectives of this study are as follows:

- To understand the causes of urban flooding in Delhi and Himachal Pradesh in order to establish any relation between the two areas.
- To suggest measures for the mitigation of urban flooding with specific reference to the role of social workers.

THEORIES OF DISASTER

Human Ecology Theory

This theory was proposed in the 1970s by Everett S. Lee and focuses on the interconnectedness between humans

and the environment. In terms of disaster, it examines how environmental hazards (floods, earthquakes, landslides) impact human systems and how anthropogenic factors (urbanisation, deforestation, pollution) influence vulnerabilities to these disasters.

Social Vulnerability Theory

It highlights how social factors shape a community's or individual's ability to prepare, respond, and recover from disasters. Catherine H. K. and Barney L., the originators of this theory, mentioned several vulnerability factors such as socio-economic status, race, age, disability, and access to resources. It emphasises targeted interventions to address the needs of vulnerable populations.

Cultural Theory of Risk

Mary Douglas and Aaron Wildavsky (1982) were the key contributors to this theory. Their book *Risk and Culture: An Essay on the Selection of Technological and Environmental Dangers* is a seminal work in this area. It explores how different cultures perceive and react to risks based on their values, traditions, and norms. Effective communication strategies must therefore consider cultural contexts.

Significant Urban Floods in India in Recent Years

Urban Floods in India

Urban flooding is a major issue around the world and has recently become a pressing issue across India, as many cities have been facing its harmful consequences. Recent events of urban floods include the Chennai floods of 2015, Mumbai floods of 2017, Delhi floods of 2020, and Himachal Pradesh floods of 2023. Flooding reaches its peak during the monsoon season, and these floods result from both natural and anthropogenic changes. However, anthropogenic factors have become the major causes of floods in recent times. Due to climate change, over 64% of sub-districts have witnessed heavy rainfall in the last decade compared with the previous 30 years (Drishti IAS, 2024). The inundation of land or property in densely populated regions as a result of excessive rainfall, overflowing rivers, inadequate drainage systems, or other water-related catastrophes is defined as urban flooding. Urban flooding causes serious consequences including damage to infrastructure, displacement of communities, unsafe living conditions, stagnant water serving as a breeding ground for various diseases like malaria, and disruption of transportation and water supply. While early warning systems and public awareness efforts can help citizens reduce their vulnerability to floods, urban development must prioritise sustainable and climate-adaptive solutions.

Table 1: Population of Two North Indian States (Census 2011)

Indian States	Total Population	Urban Population	Rural Population	Estimated Increase by 2036
Delhi	1,67,87,941	97.5%	2.5%	2.65 crore
Himachal Pradesh	68,64,602	10.03%	89.97%	77.9 lakh

Source: Census 2011, India.

Table 1 shows the population of Delhi and Himachal Pradesh according to the 2011 census. The population of Delhi and Himachal Pradesh exhibit different patterns. Delhi, the national capital territory, has seen a tremendous increase over recent decades due to urbanisation, migration, and socio-economic factors. Delhi remains one of the most urbanised regions in India, with around

97% of the population residing in urban areas and only 2.5% residing in rural areas. The population of Delhi is expected to increase to 2.65 crore by 2036. In contrast, Himachal Pradesh is a relatively rural state, with the majority of the population in rural areas (89.97%). While it still faces urbanisation pressure, in contrast to Delhi, it is comparatively less pronounced.

Table 2: Annual Rainfall Data (2019–23) in mm (IMD)

State	Year				
	2019	2020	2021	2022	2023
Delhi	546.9	678.5	904.4	675.9	565.3
Himachal Pradesh	1217.7	1052.2	1037.6	1086.4	1331.1

Source: Indian Meteorological Department (IMD).

Table 2. shows the annual rainfall data in millimetres (mm) for five consecutive years (2019–23) according to Indian Meteorological Department (IMD). In the case of Delhi, the national capital, there was an increase in rainfall from 546.9 mm in 2019 to 904.4 mm in 2021. However, after the peak in 2021, rainfall showed a decrease, with 675.9 mm in 2022 and 565.3 mm in 2023. The rainfall trend for Delhi shows a fluctuating pattern, with an initial increase over the first three years followed by a decrease during the last two years. In the case of Himachal Pradesh, rainfall showed a decrease from 1,217.7 mm in 2019 to 1,037.6 mm in 2021. However, after the decline in 2021, rainfall rose again, with 1,086.4 mm in 2022 and a substantial rise to 1,331.1 mm in 2023. The rainfall trend for Himachal Pradesh shows a decline in the first three years, followed by a rise in the last two years.

Although there was a decline in rainfall over the last two years in Delhi, urban flooding still occurred during this period, clearly indicating that rainfall alone is not the major factor responsible for floods in Delhi. A combination of other factors such as urbanisation, poor drainage infrastructure, pollution, and loss of green cover is also responsible for urban floods in Delhi. In 2023 Himachal Pradesh witnessed unprecedented rainfall, as a result of which many villages were devastated and people were rendered homeless. Such an event had not been witnessed before. This is attributable to the unique topography and climatic conditions of the state, which increase its vulnerability to floods. However, it is crucial to understand that factors including urbanisation, poor drainage infrastructure, encroachments along river banks, and tourism exacerbate flooding events. For this reason, it is imperative to improve disaster preparedness and ensure effective flood management measures.

Impact of Flooding in India

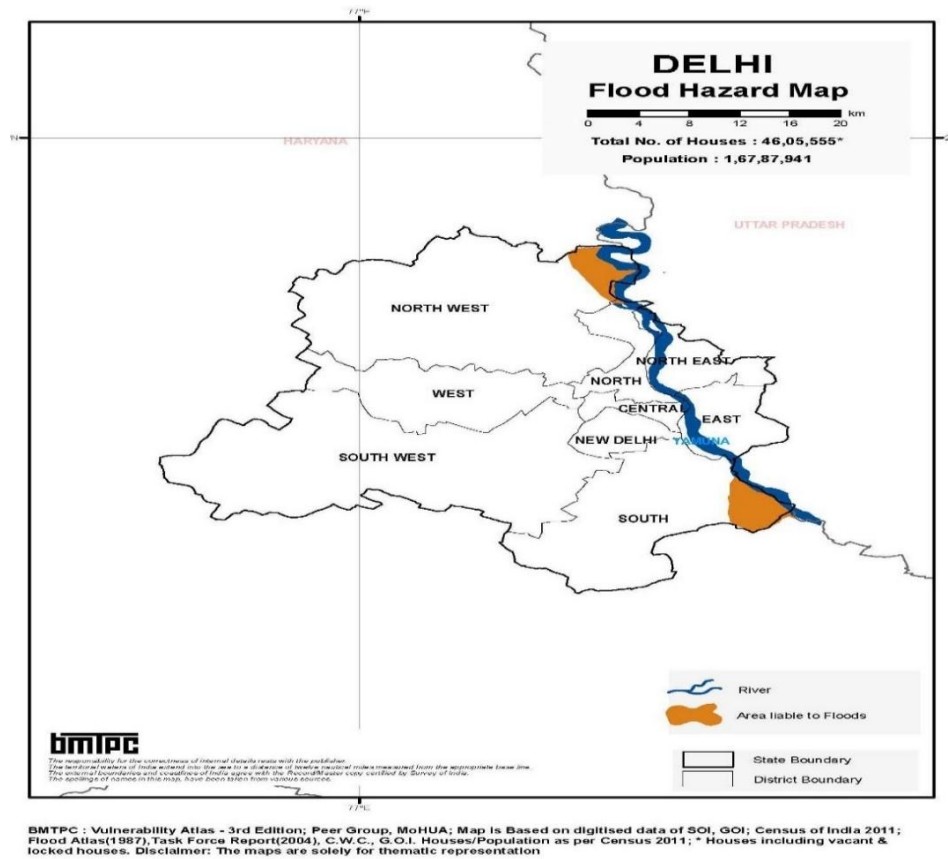
Flooding is one of the major challenges in India, causing social, economic, and environmental damage, further exacerbated by rainfall, unplanned urbanization, and climate change. According to the NDMA, on average, 1,600 people die in India due to floods (NDMA, n.d.). Floods remain the most frequent and deadliest disasters in India. There exists also a significant difference between urban and rural flooding. Urbanisation increases flood peaks from 1.8 to eight times and flood volumes up to six times (NDMA, n.d.). All major activities are usually confined to urban areas, including trade, manufacturing, industrial development, tourism, hospitality, major educational institutes, and multispecialty care. Because of urbanisation, urban regions become heavily crowded with a high population density per square kilometre. Secondary effects of flooding include severe impacts such as health issues, displacement, migration, and environmental damage. Therefore, flooding is an increasing and recent phenomenon, particularly in urban areas, placing pressure on urban planners and the government to make urban regions sustainable in ways that balance development and promote social equity, clean and healthy surroundings, and optimum resource utilisation.

Urban Flooding in India – Delhi

Delhi is the national capital of India and the most populous city in the country. It attracts a tremendous number of migrants from nearby states like Rajasthan, Haryana, Uttar Pradesh, and Himachal Pradesh in search of employment opportunities, education, healthcare, and other services. Delhi's population is mostly urban, with 97.5% of people residing in urban areas. This shows that Delhi is a major social, political, economic, and cultural hub of the country. Its population is expected to

increase to 2.65 crore by 2036, indicating rising pressure on urban infrastructure. Given the population increase and urbanisation, urban flooding has become one of the

serious concerns for Delhi in recent years. In 2024 several parts of Delhi were submerged in water for more than a day.



Source: BMTPC, Vulnerability atlas – 3rd edition.

Fig. 1: Flood Hazard Map of Delhi

Causes of Urban Flooding in Delhi

Heavy Rainfall

In recent years, the river Yamuna has become a major source of urban flooding in Delhi. It has always been a vital source of water for Delhi, providing water for drinking, agriculture, and industries, thus accounting for 70% of Delhi's water supply (Not Just Air Pollution: Water Pollution in Delhi is More Frightening, 2024). However, it has increasingly contributed to urban flooding. The river is one of the tributaries of the Ganga in northern India. It flows from the Yamunotri glacier in the lower Himalayas in Uttarakhand and flows through several states like Himachal Pradesh and Haryana before entering Delhi. During the monsoon season, when these states

experience heavy rainfall, the water level rises in river Yamuna, leading to a huge volume of water flowing into Delhi. The BMTPC (Building Materials and Technology Promotion Council) map shows areas of Delhi prone to flooding, such as north Delhi and east Delhi.

Deforestation

There has occurred a tremendous amount of deforestation in the upper Himalayas within the river Yamuna catchment area, resulting in reduced forest cover. Thus, the soil's ability to absorb water has diminished, causing more water to flow straight into the river during periods of high precipitation. This raises the likelihood of flooding by speeding up the amount of water that reaches Delhi, thereby increasing flood risks.

Encroachments

Construction along the river's floodplain has reduced the natural capacity of the river to manage excess water, thereby overflowing into nearby populated areas. Shahdara and Seemapuri are northern districts of Delhi, having unauthorised constructions of residential homes, shops, and factories, that have restricted the natural flow capacity of the river Yamuna. Consequently, during continuous spells of rainfall, these densely populated low-lying areas are highly susceptible to flooding.

Poor Drainage Infrastructure

Delhi's drainage system, dating from 1976, is quite outdated and cannot handle more than 50 mm of rainfall in a month. In recent times, rainfall has exceeded 150 mm in a month in Delhi, causing water to accumulate on narrow streets, leading to waterlogging and serious health issues.

Rapid Urbanisation

Delhi, the national capital, remains the most populous city in India. Due to rapid urbanisation, huge structures, infrastructure, and buildings have been constructed in the city. These buildings are usually made of concrete and asphalt, materials known for their strength and durability but also impervious, preventing water from percolating. During heavy rainfall, water cannot infiltrate and instead runs off, leading to accumulation on the surface and thereby causing flooding. Urbanisation has led to the reduction of green spaces like urban parks, gardens, and landscaped areas around buildings, that normally absorb water during heavy rain.

Pollution

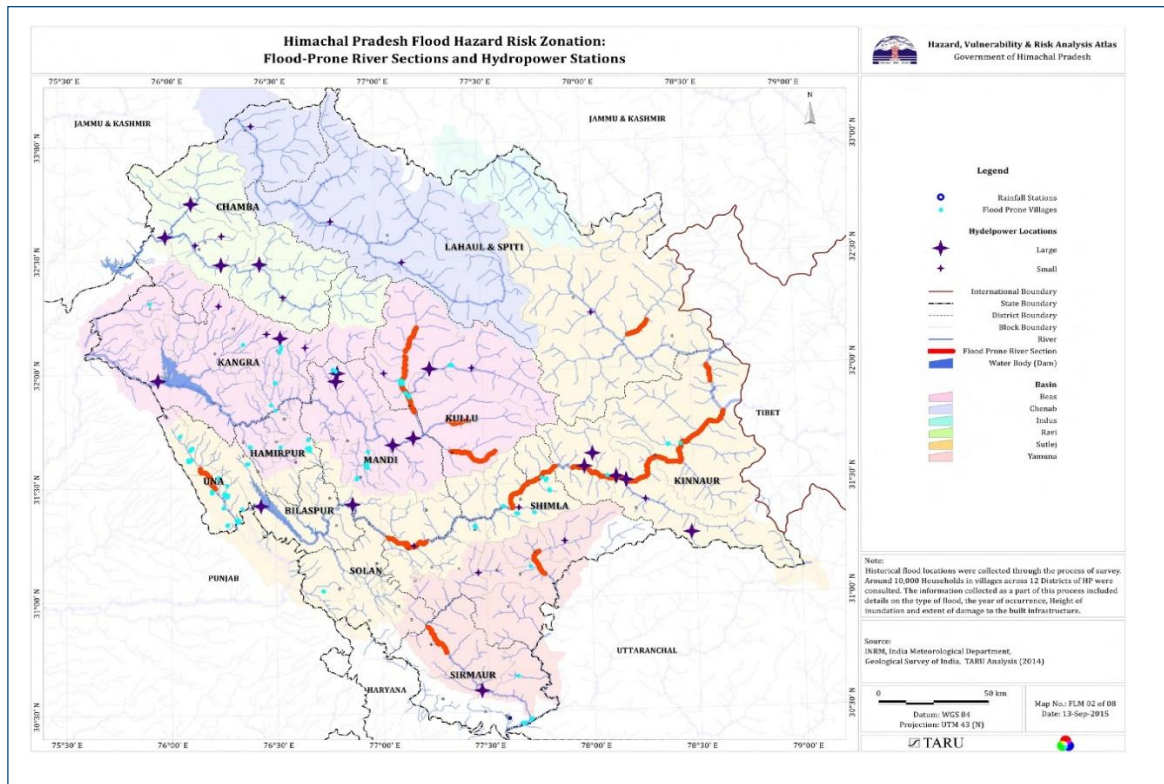
One of the main causes of urban flooding in Delhi is waste disposal. Drains become clogged by plastic, garbage, and debris during heavy rainfall, preventing free water flow freely and resulting in waterlogging. Also, untreated sewage, solid waste, and other pollutants from industries are discharged into the river Yamuna, reducing the river's catchment capacity and impairing its ability to manage floods.

A Case Study – 26-Year-Old UPSC Aspirant Tragic Incident

A tragic incident occurred on 27 July 2024, when a 26-year-old civil services aspirant was electrocuted in an inundated street in Delhi. This incident occurred during heavy monsoon rainfall in the city, when this young man came into contact with an electric wire and could not survive. In this specific case, the accumulation of water occurred due to Delhi's poor drainage system. The waterlogged street, therefore, posed a risk of electricity leakage from power lines. To prevent such mishaps in the future, the Delhi government must focus not only on managing floods but also on electrical infrastructure safety and ensuring urban spaces are resilient to climate change and urbanisation.

Urban Flooding in India – Himachal Pradesh

Himachal Pradesh is a beautiful state inhabited by people of various castes, creeds, and religious groups. Its unique composition, location, and character make it 'THE WONDERLAND'. It is located in the lap of the western Himalayas. Himachal Pradesh is a hilly and mountainous tract that attracts significant tourism. The hill state has faced intense rainfall impacts in 2023. Due to this, many villages were washed away by floods, and landslides caused huge damage to property and human life. Many families were rendered homeless due to this disaster. This was an unprecedented event that caused large-scale havoc and destruction, never witnessed before. Himachal Pradesh covers an area of 55,673 sq km and is the 18th largest state in India. According to the 2011 census, the population of this state was 68,64,602 and projected to reach 77.9 lakh by 2036. Although the majority of the population resides in rural areas, urban flooding has become an alarming issue in various districts such as Kullu, Manali, Shimla, and Kangra because these areas are close to river banks. The average rainfall trend of Himachal Pradesh is. Prominent rivers in Himachal Pradesh include the Beas, Sutlej, and Yamuna, which become voluminous and gain sudden momentum during the monsoon season (July–September).



Source: IMD, Geological Survey of India, TARU Analysis (2014).

Fig. 2: Flood Hazard Map of Himachal Pradesh

Causes of Urban Flooding in Himachal Pradesh

Heavy Rainfall

Due to climate change, the rainfall patterns become quite unpredictable in Himachal Pradesh. During the monsoon season, there can be a sudden downpour within a short period of time with high intensity and volume. Due to the steep slopes and high altitude of the state, snowmelt and glacier runoff flow rapidly downhill, increasing the velocity of water and thereby causing flash floods and flooding. Most of the rivers in Himachal flow through narrow valleys, so during the monsoon season, when water levels rise, the river becomes unable to flow into adjacent floodplains due to narrow valleys, making it more likely for water to spill over into nearby urban areas.

Tourism

Some districts such as Kullu, Shimla, Mandi, and Manali experience a high influx of tourists every year. This expansion of tourism has led to unplanned construction

and overcrowding in urban areas, contributing to urban flooding. Illegal houses and hotels have been constructed near river banks, disrupting the natural flow of river channels and thereby causing floods and widespread destruction.

Poor Drainage Infrastructure

The drainage system of Himachal Pradesh dates back to the British era in the 20th century. Since then, although efforts have been made to adapt to challenges like rain water runoff management, the drainage system remains inefficient in addressing rapid urbanisation and urban flooding, especially in districts such as Shimla, Manali, and Kullu. It remains outdated and cannot handle heavy spells of rainfall exceeding 150 mm in a day.

Pollution

With rapid urbanisation, especially in towns such as Shimla, Mandi, Kullu, and Manali, there has been an increase in solid waste, household waste, and garbage,

leading to clogged drains and water overflow. Many houses in Himachal Pradesh have adjoining streams (kulls) where illegal dumping of household waste, plastic, and debris blocks the natural pathway for water, leading to flood-like situations, especially during the monsoon season. Recently, numerous developmental activities, such as converting two lanes into four lanes and tunnel construction, have taken place in Himachal Pradesh. This has led to unchecked dumping of debris into riverbeds, restricting catchment areas and impeding river flow, thereby causing floods.

Deforestation

Some areas such as Kangra, Kullu, Mandi, and Chamba have seen an increase in the frequency of floods in recent years, primarily because of deforestation. Forest cover plays a crucial role in flood prevention by preventing soil erosion and surface runoff. Due to urbanisation, trees have been cut, and thus during heavy rainfall, topsoil is removed, and sediments flow into rivers, causing floods. Shifting cultivation, practiced in some areas of the state, has led to soil erosion, thereby increasing floods.

Mining Activities

The Beas, the longest river in Himachal Pradesh, flows through four districts of the state, namely Kullu, Mandi, Bilaspur, and Solan. Sand and gravel have been extracted from the Beas riverbed, which otherwise stabilise and regulate water flow. Due to this, the landscape and course of the river have been totally disturbed, leading to urban floods and sinking of houses built along the river banks.

Urban Flooding in Delhi and Himachal Pradesh – Similarities

From the above discussion, it can be inferred that the causes of urban flooding in both areas are more or less similar. Climate change, urbanisation, pollution, deforestation, and poor drainage infrastructure are some of the causes of urban flooding in both regions. In Delhi and Himachal, unauthorised encroachment, especially near river banks, has led to narrowing of water channels, and when continuous rainfall occurs, water peaks and momentum increase, leading to sudden floods. Furthermore, the drainage infrastructure of both the

national capital and Himachal Pradesh was built decades ago and remains inadequate for addressing clogging and urban flood challenges. According to a report by Statista, in 2022 municipal solid waste generated in Delhi amounted to 11,108 metric tons per day, while in Himachal Pradesh it was 383 metric tons per day, as the number of industries in Delhi is significantly high compared with Himachal Pradesh. Illegal industrial waste dumping into rivers not only affects aquatic life but also hinders the ability of drainage systems to effectively manage rainfall. Deforestation is another alarming issue in both areas, having reduced green cover, leading to increased soil erosion and surface runoff, thereby causing urban floods. Both Delhi and Himachal Pradesh grapple with urban flooding, and this serves as an awakening call for authorities and local residents to build safer living spaces.

Urban Flooding in Delhi and Himachal Pradesh – Differences

Delhi and Himachal Pradesh have distinct differences in terms of geography, environment, culture, language, and population. Delhi is among the most urbanised regions of India, with the majority of its population residing in urban areas, while Himachal Pradesh is predominantly a rural state. The total geographical area of Delhi is 1,483 sq km, which is small compared with its total population of 1,67,87,941, making the issue of urban flooding intense in this region. In contrast, Himachal Pradesh has a much larger geographical area of 55,673 sq km to accommodate a total population of 68,64,602. Moreover, the dense forest cover of Himachal Pradesh helps reduce the impact of urban flooding, while in Delhi, because of urbanisation, there has been a significant reduction in green cover, making urban flooding prominent. Therefore, it can be inferred that the impact of urban flooding is greater in Delhi, whereas Himachal Pradesh is more prone to sudden flash floods, landslides, and earthquakes.

Suggestions and Role of Social Workers to Mitigate the Impact of Urban Flooding

Suggestions

- Wetlands act as a sink for water absorption, and each can absorb up to 1 million gallons of water per acre.

Measures must therefore be taken to revive wetlands in urban areas.

- Water-permeable infrastructure should be built, such as the FLOAT house in New Orleans, United States. This house rests on concrete pontoons with steel and aluminium compartments, allowing it to remain buoyant.
- Designing sponge cities, where the surface of infrastructure is permeable, eliminating surface runoff and enabling greater water percolation, thus enhancing resilience against urban flooding.
- In order to enhance resilience to floods and improve air quality, vertical forests – high-rise structures with integrated plant life – incorporate trees, shrubs, and other vegetation on terraces and balconies. These ‘green skyscrapers’ fight air pollution and act as natural buffers to absorb rainwater.
- The study observes that the drainage infrastructure of Delhi is quite outdated and inefficient to cater to such a large population. Authorities must co-ordinate and take steps to review and improve the drainage infrastructure across cities.

Role of Social Workers

Pre-Flooding Situation

- Social workers can provide their expertise in policy development related to urban flooding, as they understand society in a better way and work in diverse settings. The impact of urban flooding varies from place to place, and a ‘one size fits all’ approach is ineffective. They can advocate for better drainage infrastructure and flood zoning laws.
- A social worker can sensitise the community about emergency numbers and urban flood risks, and ensure anthropogenic factors are minimised.
- Social workers can co-ordinate with NDMA, SDMA, NGOs, communities, and other stakeholders to develop a response plan for urban flooding.

Post-Flooding Situation

- Social workers can help authorities in assessing impacts and gathering information for future preparedness against urban flooding.

- Social workers can connect affected families with support systems such as NGOs and legal institutions to claim compensation within the required timeframe.

LIMITATIONS

- The study uses secondary data, which may not always be comprehensive and may have some biases. Therefore, a nuanced understanding of the causes of urban flooding may be limited.
- While the study includes two areas of India – Delhi and Himachal Pradesh – which are entirely different in terms of topography and population, it remains challenging to draw direct similarities or differences regarding urban flooding in these areas.
- The findings of the study may not be directly applicable to other regions of the country.

CONCLUSION

The study takes into account the causes of urban flooding and offers suggestions, highlighting the specific role of social workers in mitigating urban flooding. It finds that while Delhi and Himachal Pradesh are built on entirely different landscapes, the causes of urban flooding in these two areas are more or less similar. While there are significant differences in the extent of urban flooding, its impact on Delhi is very severe due to urbanisation and poor drainage infrastructure. The study also highlights that urbanisation cannot be entirely blamed for urban flooding, as many studies observe that anthropogenic activities like pollution, deforestation, and mining have influenced the climate, thereby exacerbating urban flooding. It is important to take serious steps to mitigate the impact of urban flooding, since this issue has escalated in recent times. Government authorities, social workers, and communities must ensure greater resilience against urban flooding. It is incorrect to attribute urban flooding exclusively to development without taking into account the substantial contribution human activity makes in escalating the problem. Citizens not only have the right to live in a safe and healthy environment but also bear the responsibility to maintain and safeguard it against urban flooding or other environmental hazards.

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